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Energy Modelling

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From the Editor . . .

Regular readers will understand that in general, I have few concerns about relying on regulations to set standards. It is important to have clearly spelled out yardsticks, whether it is for materials, tools or for entire buildings. I am constantly surprised to encounter sub-trades and builders who say something along the line of "we know that might be better, but we don't need to do that because the code only requires …" Unfortunately, too many in the industry, including younger industry participants and owner-builders, rely on the code as the definitive how-to manual. Too often it is forgotten that codes and regulations are not how-to or optimum construction design guides – they are meant to set a benchmark for the minimum acceptable standard of construction.

The proper question should really be what is a reasonable standard of performance. what is really needed to do the job properly. Where there are limits to available resources (including money and materials), what is the reasonable minimum. Perhaps it is code, but often it may be slightly better than code minimum without going overboard. This is especially true for insulation standards. Too often, decisions are made on the basis of short-term economics.In the not too distant past, accountants and economists had great rationales as to why it didn't really make sense to put too much insulation into the wall, and when it came to windows, not to bother too much beyond simple double-glazing for windows. Arguments were (and sometimes still are) made in the context of very short-term payback analysis. Very few would dare say that today. Economics are influenced by social and political forces other than simple supply and demand.

This is also where regulations, regulators and other industry professionals come into the picture. Long-term visions need to taken into account. Because we are creatures of habit, sometimes we need to be kicked in the butt to move along, rather than just continue with the tried and true that we've become accustomed to.

I have written in the past about the questionable decisions made by building officials – using narrow interpretation of codes and standards and influenced by personal and regional biases. At the same time, I hear from building officials that they are not always given the support and authority to question practices they see in the field, nor are they given the discretion to consider basic building science principles when interpreting what is being done on the jobsite. Some things they see are very dubious, and although on the surface they may comply with the written text of the building code, they may not be appropriate for a given situation.

Conscientious building officials do give some advice and press builders to do the right thing, but most of the time they dare not press too much, since they are administering the building code that only sets out a minimum standard.

Although no one really likes intrusive oversight of their activities, we really need to become comfortable with third-party reviews. We should consider the oversight as an extra pair of eyes that enhances the quality of the product we produce - part of a quality assurance process, and not treat it as a police action.

Richard Kadulski,
Editor

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Energy Modelling

As codes and standards set higher performance requirements, builders and designers are pushing to stay ahead and move beyond the new minimums. The direction of housing standards is moving in the direction of Net Zero housing – homes that essentially have no need for external energy. In Europe, goals have already been set for 'carbon-neutral' construction.

Although housing codes set high standards, they generally offer prescriptive requirements. These allow builders to follow a recipe that should achieve the desired performance level for the average house. However, just following the prescription does not guarantee achievement of the desired goals.

Experience in Vancouver has shown that although the city has introduced very high-energy efficiency requirements that should theoretically attain EnerGuide ratings of around 80, the average is closer to 75 – this despite high nominal insulation requirements.

To achieve real benefits requires careful attention to detail at both the design stage and during construction.

Increasingly, homebuilders will be looking at the results provided by new design tools that will also help optimize the design. To achieve Net Zero at optimum cost, detailed modelling is essential – especially early at the design stage before particular configurations are locked-in.

All heat loss calculations are based on basic physics formulas. They essentially recognize that heat loss is a function of the surface area of an assembly, its thermal conductivity (or resistance to heat flow) and the temperature difference across the element.

In the past, before we had computers, all calculations had to be done manually, with the aid of simple calculators. Analysis included many shortcuts, rules of thumb, and occasionally, reliance on charts and graphs that had been developed by trial and error and lengthy manual calculations.

We now better understand that building energy heat flows are complex and influenced by more than just the building envelope assemblies, but also the house as a whole. The airtightness of the building as well as the thermal storage capacity of the materials, solar heat gains, internal gains from occupants and indoor appliances, will all influence the energy performance of the house.

There are a variety of energy analysis software tools available today. We are lulled by the seemingly endless variety of apps that will do almost anything. However, as with any tool, you need to know what it can and cannot do and how to use it properly.

Most of the software applications have been developed to support various energy efficiency, green building and marketing programs. So it is important to be aware what the intent of the software was, why it was developed, what are its capabilities, and how accurate it is. What weather information is used and what is it capable of doing? There will be assumptions made about certain elements, so it is useful to understand what they are and how that will affect the results of the simulations. All of these elements will impact the accuracy of the results.

All energy analysis software requires users to have an understanding of the construction and operation of residential buildings and involves some study and familiarization with the application.

In Canada the most common residential energy analysis software used is HOT2000.

It has been validated extensively against hourly simulation programs and monitoring of real houses across the country. It is used as a compliance tool for the R-2000 program and for EnerGuide house ratings as well as by regulators for energy code compliance. Consequently, there is a large group of qualified energy evaluators across Canada.

The energy component of LEED Canada for Homes relies on HOT2000, as there is a minimum EnerGuide rating requirement. As an option, LEED uses the American HERS scale, which has its own software (REM/rate) but with a limited number of Canadian weather files, its suitability for use in Canada is limited.

HOT2000

HOT2000 was developed as a tool to assist builders and designers to design energy-efficient,

low-rise residential buildings. It uses up-to-date energy loss, gain, and mechanical system performance models. The program aids in the simulation and design of buildings for thermal effectiveness, passive solar heating and the operation and performance of heating and cooling and domestic hot water systems.

Building data is entered with detailed information about the building geometry, construction characteristics (above and below grade). The analysis uses effective thermal values, not nominal R-values. It takes into account thermal bridging through studs in assemblies, has a detailed air infiltration model and foundation heat loss model. Also, heating, ventilation, cooling equipment and domestic hot water specifications are used, as is the geographical location of the house. The data is entered through a graphical user interface.

HOT2000 can be used to optimize the building design to meet specific energy efficiency requirements. Over the years it has been upgraded to use the latest energy modelling information. In the near future, a new version will be available to address the new R-2000 Standard requirements and next generation Energy Star and EnerGuide standards. It will have a code energy compliance option as well.

HOT2000 is also used in the United States as well as Japan and Europe.

Reports on the house analysis, weather file, economic and financial conditions and fuel costs are available. The house analysis includes detailed monthly tables, annual heat loss and HVAC load results. A comparison report allows for the display of results of up to 4 house files at once. HOT2000 only works in Windows. It can be run in English or in French and in metric, imperial or U.S. units.

The results are produced quickly and are whole-house energy analysis and can be used to determine annual energy use and help to determine cost effectiveness of energy efficiency upgrades.

Features to Consider In Energy Modelling Tools

- **Data inputs**: does the software make assumptions or require specific inputs?
- **Do building envelope entries** require detailed construction make-up information so that effective R-values are computed, or is data entry done with pre-calculated generic assemblies or nominal R-values?
- **Solar heat gains**: how is shading and window performance handled? How many orientations does the software consider?
- **Weather data**: is weather file information available for your location? What kind of weather data is used? It could be hourly, daily, monthly data.
- **Airtightness data**: does the software take into account various levels of airtightness?
- **Does it consider stack action**?
- **Mechanical Systems**: does the software model central ventilation systems with and without heat recovery? Does it model various mechanical systems?
- **Internal loads**: how does the software deal with energy use and heat generated by people, lights, and appliances?
- **Default assumptions**: be clear about assumptions for standardized operating conditions when doing energy modelling. These will include occupancy, temperature settings in the house, ventilation, light and appliance use, domestic hot water consumption, and weather.

PHPP (Passive House Verification software)

The Passive House initiative, the European high-performance building standard, has developed PHPP – a comprehensive analysis tool. It is an Excel spreadsheet-based software for energy calculation. It uses 30 worksheets for data entry and to perform calculations. As a spreadsheet, most formulas and assumptions are visible, making the software very transparent.

Data entry requirements are detailed and can be complex. As a European tool, some of the data entry values will be unfamiliar to a Canadian user. There is little Canadian data in the database within the software. There is also a reliance on specific product certifications, rather than simply performance based on any combination of products that will achieve the desired result.

PHPP uses very comprehensive data inputs. Thermal bridging details and solar shading from nearby obstruction is taken into account. In addition, very detailed interior electrical load calculations are done. Unlike HOT2000, for which data entry can take an hour or two once a template has been created, the PHPP can take a full day or more to complete.

Reflecting European regulatory concerns, the energy calculations consider the source of primary energy used by the house and its impact on CO_2 emissions.

How Do The Results Compare?

Although the calculation formulas are essentially identical, each software uses slightly different ways of putting the formulas together. As a result, the results are going to vary.

An analysis done by Stuart Fix of the energy performance of several Net Zero energy homes built by Peter Amerongen in Edmonton points out the variations that can happen. Some of the variations happen as a result of the assumptions that are used within the software. Others may be based on built-in biases and quirks. In the case of homes with very small energy demand, such as Net Zero homes, even small variations may appear significant.

Stuart and Peter observed when the same houses were modelled in HOT2000 and PHPP, HOT2000 predicted smaller heat loads compared to PHPP. The main difference was because of differences in calculating solar heat gains (PHPP was more conservative than HOT2000) and internal gains (HOT2000 assumed larger internal gains than PHPP).

In very low energy buildings, solar gains are important, but also difficult to predict accurately due to unknown factors such as landscape and adjacent building impacts and weather variability.

Internal gains are important – those lights, TVs and other electronic gizmos found in homes today become more important the more efficient the home. Some programs place much effort on these. PHPP and the US HERS allow input in great detail, while HOT2000 relies mainly on a daily global quantity. It is obvious that the more detailed the input, the more accurate the result will be.

However, the challenge with calculation of internal heat gains is that people live in these houses, and there is no 'standard person'. The number of people in the house, their lifestyle, and the number and type of appliances and electronics, and their usage, will have a big impact on the energy use in the house. A couple of big screen TVs and teens in the house can significantly affect the internal loads, and hence overall house performance.

How Much Accuracy Is Needed?

For an academic analysis, we need a high degree of accuracy. However, when modelling houses, is it important to be 100% accurate? Codes and most energy efficiency and green building programs operate with a number of operating assumptions for ease of comparisons, so that analysis may not reflect actual operating energy consumption.

We know that each energy analysis tool will have its quirks and result variations in results. This is the challenge for those aiming for Net Zero energy. It may be achievable on paper, but not when people are put into the mix, as people don't always behave in the way the analysis assumes. When modelling for the sake of fine-tuning a design, the last 2 or 3% efficiency may not matter. While using it as a research tool, however, we may be concerned about that.

As we move towards Net Zero energy buildings, it is much more important that the majority of new and renovated buildings approach the desired performance level, rather than just having a handful of unique homes.☼

LEED Canada for Homes Updates Minimum Energy Benchmarks

LEED Canada for Homes was introduced in early March 2009, and has certified 350 homes to date. Reacting to criticism of the low minimum energy efficiency threshold for participation in the program, the CaGBC has announced that the new minimum for energy performance in the LEED Canada for Homes rating system will be EnerGuide 80 for all homes registered after Aug. 1, 2012.

In keeping with this change, the prescriptive and HERS (Home Energy Rating System) paths will also be adjusted: a HERS score of 72 will be required, or if using the prescriptive path a minimum of 8 points will need to be achieved from EAc2, EAc3, EAc4, EAc5, EAc6 and EAc7.3.

HERS is the principal US home energy rating system with a scale that is opposite to the Canadian EnerGuide rating. The HERS ratings provide a relative energy use index where 100 represents the energy use of a standard American house and 0 (zero) is a Net Zero energy building that uses no net purchased energy. The lower the value, the better.

Information on LEED Canada for Homes: *www.cagbc.org/homes*.

The New R-2000 Standard

R-2000 is celebrating 30 years of industry leadership this year. For some, the standard may seem old hat and dated. However, with the latest updating of the R-2000 Standard that came into effect July 1, the standard maintains the leadership role it has had since it was first introduced in 1982.

The 2012 R-2000 Standard has an energy performance benchmark that is 50% more efficient than current energy code requirements (equivalent to EnerGuide 86). The new standard is being introduced in two phases, with the full roll-out in 2014.

R-2000 has a deep history in Canada. It was born in the wake of the Saskatchewan Conservation house that was built in 1977. The Saskatchewan Conservation House was a proving ground for concepts of super-insulation, passive solar design and heat recovery ventilation, and attracted international attention. "The house-as-a-system" approach to construction design ultimately became the Canadian way of understanding and evaluating how houses work. It became the basis of every energy-efficient home initiative around the world in the following years.

The concepts that were demonstrated and proven in the Conservation House soon after were applied by a group of Saskatoon builders in their Parade of Homes. The technical standards of those houses would later become the basis of the R-2000 program.

R-2000 houses are energy efficient, environmentally responsible, durable, and have exceptional indoor air quality. They are designed and built to conserve natural resources of construction materials, including wood and water in addition to energy. They make better use of renewable energy than ever before, whether it is passive solar, captured through better window technologies, or active solar technologies for domestic hot water heating or electricity generation.

R-2000 is a voluntary standard. Builders who choose to build to the R-2000 Standard do so because they want to. Because of this approach, builders have a strong sense of ownership in R-2000. They offer it to their customers with a passion and enthusiasm that comes from knowing that they are building the best houses in the world.

R-2000 is an initiative that has been able to get the whole building industry working together towards a common goal. The Canadian Home Builders' Association has been a partner with the federal government since the beginning of the initiative. Homebuilders across this country have supported, promoted, and built R-2000 houses for more than 30 years.

Over the years we have learned many lessons by building R-2000 houses. Many of the innovations in the building industry have been made by builders striving to attain the R-2000 targets. Many of these innovations can be seen in every new house built in Canada today. Although much of this innovation came from builders, it also came from product manufacturers and from government-supported research and development.

The first house built to the new 2012 R-2000 Standard was completed at the beginning of this year in Ottawa.

The first house in Western Canada built to the new standard is presently nearing completion in Vancouver. It is being built by Arthur Lo, principal of Insightful Healthy Homes Inc. When completed, the house will be the first of the next generation of R-2000 homes in BC and is expected to comply with the 2014 version of the standard.

The Vancouver house is an infill house in an established neighbourhood. It has been designed with aging in place in mind. The 2 ½ storey, slab-on-grade house has a secondary suite on the ground level that is fully accessible.

Insightful Healthy Homes Inc. Vancouver house under construction. When completed, the house will be the first of the next generation of R-2000 homes in BC and is expected to comply with the 2014 version of the standard.

The exterior walls are prefab double 2x4 wall for a total wall thickness of 11". The insulation is Icynene spray foam filling the full cavity, for a total effective R-value of around 48. The roof structure is 10"-thick structural insulation panels with an additional R-14 mineral wool insulation for an effective R-53. Windows are triple-glazed fibreglass-framed with double low-e glass. The slab-n-grade foundation has R-20 rigid insulation under the entire slab, plus R-20 along the slab edge.

The house has a very small design heat load of 17,000 BTU/hr (5 kW). The heating will be supplied by two small ductless mini-split heat pumps. A 2-panel solar system will pre-heat the domestic hot water.☼

Ductless Heat Pumps

Ductless heat pumps, sometimes referred to as "mini-split" heat pumps, tend to have a smaller capacity (BTU/hour or "tonnage" rating). They have a separate compressor outside and an expansion heat delivery unit inside, similar to traditional heat pumps. One or more inside units deliver conditioned air to the room or rooms inside. The interior units are typically mounted high on the wall but some models can be recessed in the ceiling or even installed with a short duct run to serve adjacent rooms. The inside and outside units are connected by refrigerant lines, usually concealed in the walls or ceilings or under a cover on the outside of the house. Depending on the rated capacity they require 110 or 220 volt AC power.

Ductless heat pumps operate on the same principle as traditional heat pumps, using electricity to move heat between outdoor and indoor air by compressing and expanding a refrigerant. Most new ductless heat pumps use the newer, less environmentally harmful refrigerant R-410a. Like any air conditioner, in cooling mode they provide some dehumidification of the indoor air.

Ductless heat pumps are very efficient for several reasons. Since the heated or cooled air is delivered directly to the room, ductless heat pumps avoid efficiency losses associated with ductwork – which typically can be about 15 to 20%, as well as the need for drops and bulkheads to accommodate the ducts. Variable speed compressor models, usually labelled "inverter" drive, avoid on-off cycling losses and are able to operate at close to maximum efficiency on all but the coldest days. And because they provide heat/cooling to specific areas of the house, they can be more efficient since each "zone" can be heated to the desired temperature.

Ductless heat pumps are most appropriate for homes with open floor plans, as each indoor "head" can serve a much larger area of the home. They're appropriate for new energy efficient and retrofitted homes with small heating loads, although multiple units can be installed in larger homes.

The Future of Canadian Housing: Nova Scotia Examples

Canadian homebuilding technology has advanced significantly in the last half century, especially with the support of research and advanced housing demonstration programs and initiatives such as R-2000. It is well placed to meet the requirements of the 21st century. The newly revised R-2000 Standard is setting a bar that is moving in the direction of Net Zero housing.

Many of the Net Zero and near Net Zero high performance homes being built are demonstration homes, but their builders generate a lot of buzz and get customers who want such a home.

In the fall of 2010, Efficiency Nova Scotia and the Nova Scotia Home Builders' Association (NSHBA) issued a challenge to Nova Scotia architects and home designers to design an affordable energy efficient home with a minimum EnerGuide rating of 92. This was followed with a challenge to homebuilders to build these homes affordably. The demonstration homes help show homeowners how to reduce the size of their carbon footprint while saving money on energy costs each and every month.

Two homes were built – one in Sackville, Nova Scotia, the other in Dartmouth. One achieved an EnerGuide rating of 94, the other 96.

Dartmouth, NS house

The Dartmouth house is a single-family detached home located on a corner lot that achieved an EnerGuide rating of 94. This four- bedroom, 3½ bathrooms, R-2000 home has more than 3,300 square feet of living area on 3 finished levels. The basement is finished and also includes a one-car garage.

There is a natural gas fireplace in the living room to provide ambience and a bit of heat during the cold winter months. A walk-in pantry in the kitchen provides additional storage of food and other housewares.

Features of the Dartmouth home:

Building Envelope:
-Foundation: R24
-Exterior Walls: R35 - dry blown cellulose insulation in 10" thick walls with staggered 2"x4" studs
-Attic: R60 - cellulose insulation
-Triple-glazed windows (facing south)
Mechanical shutters

-Mechanical Systems:

-An air-source heat pump with natural gas backup
-16 photovoltaic (PV) solar panels
-2 solar thermal panels for domestic hot water
-Instant hot water system in kitchen
-Drain water heat recovery (DWHR) system

Additional Features:
-Comprehensive automated monitoring system
-Natural gas hookup for appliances and fireplace
-Cork flooring and SmartStrand carpet
-CFL and LED Lighting

Whitestone Developments Ltd., Lakeside, NS
www.whitestonedevelopments.ca

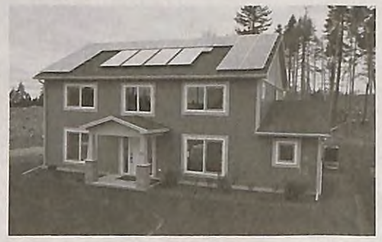
Sackville, NS house

The second home, located in Lower Sackville, is a two-level, single-family dwelling that achieved an EnerGuide rating of 96. This home is 2,304 square feet, featuring an open concept layout with 3 bedrooms and 2½ bathrooms.

The main floor is built on an 8" engineered slab featuring a 6" layer of foam beneath the slab with an acid-stained finish. It also features four solar thermal panels heating water - two panels are for domestic hot water and two for in-floor radiant heating. Twenty photovoltaic solar panels are installed on the roof to generate electricity.

Features of the Sackville home include:

Building Envelope:
Foundation: R25 - type 3 expanded foam under slab
Exterior Walls: R42 - wet sprayed cellulose insulation with 1" foil faced foam over 10" walls with staggered 2"x4" studs
Attic: R60 - cellulose insulation
Triple-glazed windows



Mechanical Systems:
An air source heat pump
20 photovoltaic (PV) solar panels
2 solar thermal panels for domestic hot water
2 solar thermal panels for in-floor heating
Drain water heat recovery (DWHR) system

Additional Features:
Recycled quartz countertops
Comprehensive automated monitoring system
Integrated/mobile lighting and electrical control
CFL lighting

Denim Homes Inc., New Minas, NS
www.denimhomes.com

You Asked Us: About Vapour Barriers

I am a contract building official from Saskatchewan, and big fan of Solplan Review.

Is there any research regarding the adverse effects of our typical wall and ceiling assembly designs, with a 6-mil poly AVB located in the wrong location during our warm humid summer months?

On several occasions over the past two summers I have noticed condensation dripping down the inside of the poly (prior to drywall) inside the wall assembly. All cases were cool basements, during very hot periods. A couple of the houses were clad with black/charcoal coloured acrylic stucco (without exterior insulation, just house wrap and stucco).

It occurs to me that for a few months a year, where temperatures might reach 30+ °C and we air condition our homes to 21-22°C, we are essentially in an environment like in Texas, and our air/vapour barrier is on the wrong side of the assembly. I am curious as to any studies that may have been done, or any literature available that addresses this issue. After seeing it, I was surprised I don't see it or hear about it more often. One homeowner was told it was because they chose such a dark stucco. Would the use of acrylic stucco be a factor?

CG
Saskatoon, SK

The use of poly inside our homes has generated much discussion. Before tackling your question, we need to be clear about a couple of issues.

As used, the poly serves a couple of functions. Firstly, and most important, the poly is intended to serve as the air barrier. An airtight building assembly is important for building durability – to minimize air leakage and with it the movement of moisture where it can condense. The air barrier needs to be continuous, as it is air movement through the envelope that is the major driver of moisture movement, and with it, moisture induced deterioration.

Secondly, the poly is a vapour barrier – a barrier to vapour diffusion through the assembly. Vapour diffusion is driven by the vapour pressure differential across the building assembly. Under normal conditions, vapour diffusion is a minor factor in moisture movement.

The use of poly has become the norm only in the last generation. Most builders and code officials are now comfortable working with it, and it does provide an easy to inspect detail. However, as you've observed, there are issues with its use.

The Building Code defines a vapour barrier as any material with a vapour permeance of less than 60 ng/Pa-s-m^2. Typical 6-mil poly has a permeance of about 6 ng/Pa-s-m^2. While these numbers are minuscule, they are important to the understanding of moisture movement across building envelope. There is much debate in the building science community about the merits of using polyethylene as the air barrier in construction. A small amount of vapour diffusion may be acceptable in some circumstances.

In Canada the length of time when we see hot humid conditions where a reverse vapour drive may occur is quite short. Canadian climates are heating dominated, even in southern Ontario, with their increasingly longer humid summers.

In your case, you were looking at new houses, where there are larger quantities of moisture due to construction moisture that has not yet dried.

In above ground assemblies, depending on conditions, drying can generally take place two ways – towards the interior or the exterior. Experience has shown us that unless you place a very low permeance material on the exterior as well as the interior of the assembly without any ability to vent and dry, there should be no problems.

However, below grade the conditions are different, and that is the area you were looking at. In the basement, the only way drying can take place is towards the interior, as the ground is always cooler and more moist than the interior.

While we still need a vapour diffusion retarder in the basement, it should be more permeable than poly to prevent the moisture build-up that you've observed. Good practice would be to reduce the potential for capillary moisture entry into the concrete. This can be accomplished by ensuring the wall footing rests on a drainage layer, and that the footing be wrapped in a waterproof material, such as a waterproof fabric footing form, or lining the footing form with poly.

The other good building practice for basements would be not to insulate and seal the basement for up to a year after construction so that a major portion of drying can take place - but this may not always be possible.

Then, there are several options for the interior finishing to reduce moisture problems.

If wood furring and batt insulation is being used, you could use an airtight drywall approach to the air sealing, and use a vapour barrier paint (a low-perm drywall primer) on the interior finish.

You can use spray foam insulation between the furring – the foam adheres directly to the concrete and furring. If the spray foam insulation is medium density 2-pound polyurethane foam, the vapour barrier is already there, due to the low permeance of the spray foam itself. If the spray foam is the open-cell half-pound foam, then a vapour barrier paint can be applied directly to the foam insulation, or it can be applied on to the drywall.

You can also install 1 ½" extruded polystyrene directly against the concrete, then furr and install additional fibrous insulation on the interior. In this case, the interior face of the extruded polystyrene insulation provides the vapour barrier function.

A 'breathable' vapour barrier is an alternative membrane to polyethylene. Currently, there is only one product on the market – MemBrain™, manufactured by Certainteed. This is a nylon film that has a variable water vapour permeance. When the water vapour pressure increases within the wall cavity, the water vapour can diffuse through the interior drywall into the interior.

The National Research Council had a multi-year research project on basement envelope systems. The report, titled *Performance Guidelines for Basement Envelope Systems and Materials* by Michael C. Swinton, and Ted Kesik is a good summary of basement construction issues. It is readable and worth reviewing. The document is available on the National Research Council website.

Unfortunately, the NRC website has been redesigned, and is now much less user-friendly than in the past with many non-functioning links. However, you should still be able to access the document by going to: *http://www.nrc-cnrc.gc.ca/eng/ibp/irc/rr/rr199/index.html* and going to the archived site.

Basement insulated with 2" rigid extruded polystyrene against the concrete foundation wall. Batt insulation will be installed in furring and drywall will be installed on interior. There is no need for polyethylene in this assembly.

A "Smart" Vapour Retarder

MemBrain™ is a vapour retarder intended for use with unfaced, vapour permeable insulation (fiberglass and mineral wool) in wall and ceiling cavities. It is a polyamide film that changes its permeability with the ambient humidity condition. This product can be used in place of traditional vapour barriers, but it is not suitable for use in locations with constant high humidity.

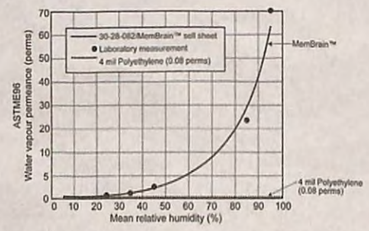


Figure 1. Water Vapour Permeance of "MemBrain™" compared to 4 mil polyethylene. (1 Perm = 57.45 ng/Pa·s·m²)

The product's permeance is less than 1 perm (60 ng/Pa-s-m^2) when tested in accordance with ASTM E 96, dry cup method, and increases to more than 10 perms using the wet cup method. This variability allows for drying and prevents the build-up of moisture within building assemblies. When the relative humidity increases above 60%, the pores in the material expand and its permeability increases, allowing the assembly to dry by vapour diffusion in either direction, thus decreasing moisture accumulation within the construction and potential moisture damage.

CCMC Evaluation Report 13278-R
Information: www.certainteed.com

Technical Research Committee News

Canadian Home Builders' Association

National Building Code Energy Standards

The Canadian Commission on Building and Fire Codes (CCBFC) approved a new section of Part 9 of the National Building Code (9.36) for energy efficiency for houses and (some) small buildings. The new requirements incorporate changes based on responses from the public review held early this year, and will be published as an interim change to the 2010 NBC in late 2012. The CCBFC also approved a new guide to assist provinces in adapting the National Energy Code for Buildings to their particular region.

Fire Sprinklers

Mandatory sprinkler requirements are an ongoing topic. The CCBFC has formed a task group to review the comments received on a study done for the Canadian Code Centre regarding the case for mandatory sprinklers in new houses and whether the standing committees should deal with the code change requests received. The consultant's report concludes that mandatory sprinklers would be very costly relative to other life-safety measures.

CMHC EQuilibrium Housing Forum

The third in a series of CMHC EQuilibrium Housing Forums (2012) will be held in Vancouver, BC on Oct. 23-24, 2012. Previous forums were held in Edmonton, Alberta (2009) and Montreal, Quebec (2010). The forums provide an opportunity for attendees to learn directly from builder teams about the challenges faced and opportunities realized in designing and delivering EQuilibrium™ sustainable housing projects, and discover what can be done right now to design and build sustainable housing and capitalize on this business opportunity.

This forum will provide in-depth information, analysis, discussion and lessons learned from four EQuilibrium™ Housing projects: Harmony House, in Burnaby, BC; The Green Dream Home, in Kamloops, BC; the EchoHaven project in Calgary, AB; and the Urban Ecology project in Winnipeg, MB. In addition, the Now House EQuilibrium™ Housing retrofit project in Toronto will be presented in a public lecture event.

ULC Standards Updates

Ethanol (denatured alcohol)-burning flueless fireplaces were developed in Australia and are now being heavily promoted in North America. Sleek, contemporary designs are part of the promotional pitch, with claims of being environmentally friendly and, because ethanol burns clean, low maintenance. Because they don't require a flue, the manufacturer is pushing them for use in apartments.

However, there is no standard applicable to these units. ULC is working on CAN/ULC-S674, *Standard for Unvented Alcohol Burning Decorative Appliances.* They are developing the first edition of this standard. It is intended that this standard will be published in the near future.

GE Recalls Dishwashers Due to Fire Hazard

The US Consumer Product Safety Commission and General Electric announced a recall of dishwashers sold under the GE, GE Adora™, GE Eterna™, GE Profile™ and Hotpoint® labels. The recall is because an electrical failure in the dishwasher's heating element can pose a fire hazard. GE has received a number of reports where the dishwasher heating element caused fires, three of which caused extensive property damage, although no injuries have been reported.

They were sold in black, white, bisque, stainless steel and CleanSteel™ exterior colors and finishes. The model and serial numbers can be found on a metallic plate located on the left tub wall visible when the door is opened.

Affected models will start with one of the following sequences:

GLC4, GLD4, GLD5, GLD6, GSD61, GSD62, GSD63, GSD66, GSD67, GSD69, GLDL, PDW7, PDWF7, EDW4, EDW5, EDW6, GHD4, GHD5, GHD6, GHDA4, GHDA6

Serial numbers start with one of the following sequences: FL, GL, HL, LL, ML, VL, ZL, AM, DM, FM, GM, HM, LM, MM, RM, SM, TM, VM, ZM, AR, DR, FR, GR

For additional information, contact GE toll-free at (866) 918-8760 or *www.geappliances.com/recall*

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.
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You Asked Us About: Radiant In-Floor Heating

We are building two homes in Whitehorse where the clients have opted for Warmboard as their structural floor sheathing and as the distribution system for in-floor radiant. The product's feature is an aluminium skin bonded to the surface and piping grooves as a rapid and even transmitter of heat to the finish flooring, thus allowing for energy savings with set-back thermostats and lower boiler temperatures.

My question relates to the use of underlay under the engineered flooring that one owner has chosen. Many underlays have some R value that would somewhat, if not substantially, negate the advantages of the Warmboard.

Are there any concerns?

RW
Whitehorse, YT

Floor radiant heating has been used since Roman times in Europe, and in Asia for more than a thousand years. Radiant floor heating heats the house by applying heat underneath or within the floor.

Today's hydronic radiant floor heating systems use plastic pipes laid within the floor to carry hot water into specific zones, dispersing the heat through the floor surface. Typically, tubing used is a leak-resistant, non-toxic, high temperature, flexible piping called cross-linked polyethylene (PEX). PEX is a durable tubing that doesn't become brittle over time, isn't affected by aggressive concrete additives or water conditions, and has been in use since the 1970s.

The ideal systems would have pipes encased in a concrete slab or in a concrete or gypsum cement topping, as these provide some thermal mass that can maintain more consistent conditions. However, the pipes can also be laid into thin grooved panels that nail on top of a subfloor, or be suspended below a wooden subfloor using metal fins fastened under the floor surface.

You are describing one manufacturer's subfloor material - a plywood subfloor material manufactured with tubing grooves and aluminium heat diffuser plates built into them. The grooves are guides for the layout of the tubing to allow consistent spacing. This product makes a radiant floor system (for new construction) easier to install. The aluminium plates allow for faster heat transmission.

In all cases, the heat output is determined by the pipe spacing, water temperature, flow rate and the finished floor covering. The heat output must be calculated to meet the heat loss demands of the home. Radiant heating also has temperature limits for operation – the floor surface cannot exceed 84°F (29°C) – that may define the maximum heat output of a system, based on the overall heat loss of the house.

The use of carpeted floors or other finished floor underlayments that could be considered to be insulating materials will reduce the system efficiency somewhat, but if they are properly considered at the design stage, it will perform efficiently. Floor radiant heating still requires insulation under the piping, whether it be under a concrete slab, or under the floor sheathing in the joist cavity.

Compact fluorescent lamps

Environmental issues are a top priority for many consumers, which is why compact fluorescent lamps (CFLs) have become a common feature, and are in fact being mandated in some circumstances. But concerns are still being raised about them.

CFLs are a fluorescent bulb designed to emit as much light as traditional light bulbs while using less energy. CFLs use about 75 percent less energy than standard incandescent bulbs and can last up to 10 times longer. CFLs also produce about 75 percent less heat, so they're safer to operate and can cut home cooling costs.

Although consumers are receptive to these energy-saving products, conflicting messages are leaving people confused about the safety of CFLs, specifically regarding mercury and end of life issues when the lamp burns out.

CFLs' End of Life

With the incandescent lamps, the bulbs burn out with a pop, a flash and, when shaken, a rattle, confirming that the bulb needs to be changed. With CFLs, the burn-out of a CFL is different. The light dims over time and might produce a more dramatic pop, emit a distinct odour, and maybe even release some smoke. In some cases, the plastic at the base of a CFL can turn black, but this is also normal in most cases, as safety

standards require the use of special flame retardant plastics in the base that do not burn or drop particles.

Many brand-name manufacturers are now incorporating innovative end of life mechanisms into CFLs that cause the bulbs to burn out more like the traditional incandescent bulbs. The UL Mark on CFL packaging indicates that representative samples have been tested for safety hazards, and meet standards.

CFLs and Mercury

For decades consumers have heard about potential dangers associated with mercury, often associated with thermometers and vaccines for children. Today, consumers are again hearing about mercury as CFLs contain a small amount of mercury sealed within the glass tubing. Each lamp has less than 4 milligrams (some as little as 1 mg), which is about the amount that would cover the tip of a ballpoint pen. (By comparison, older thermometers contain about 500 mg of mercury). Manufacturers recognize the concerns associated with mercury and are working to reduce mercury in fluorescent lighting products.

Mercury is a critical component of CFLs as it is what allows the lamp to turn on. No mercury is released when the lamps are intact or in use, and if the lamp is disposed of properly, mercury in CFLs shouldn't be a safety hazard. Because CFLs contain a small amount of mercury, they should be recycled rather than thrown out in the trash. Special considerations should be taken if a CFL should accidently break.

Like batteries, paint, computers and other products that contain hazardous elements, CFLs should not be thrown in the garbage. They should be disposed of safely through available recycling programs.

However, scientists at the Lawrence Berkeley National Laboratory in the US found that the amount of mercury a person is exposed to cleaning up a broken CFL lamp is equivalent to eating a single meal of albacore tuna.

Beyond CFLs

CFLs aren't the only energy-saving lighting option available today. New lighting coming on stream are light-emitting diodes, or LEDs, which are small light sources illuminated by the movement of electrons through a semiconductor material. LEDs produce more light per watt than incandescent bulbs, making them exceptionally energy efficient. In fact, many LEDs use up to 90 percent less energy than an incandescent bulb to produce the same amount of light.☼

July in September?

Regular readers may have noted a delay with this issue of Solplan Review. Circumstances beyond our control caused a delay in production. We are on track now to make up for lost time, and subscribers will receive the regular number of issues as part of their subscription.

Our apologies.

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NRC·CNRC

Health and well-being through residential windows

Interest in using light to the benefit of building occupants through daylighting and lighting design has never been higher. In 2001, physiologists discovered a new cell type in the human eye. These cells (known as "intrinsically photoreceptive retinal ganglion cells") send information about light intensity to the brain centres that are responsible for controlling circadian rhythms to patterns of light and dark, so that we sleep when it is dark and awaken in light. This discovery and related research led the Commission Internationale de l'Eclairage (CIE) in 2004 to create five principles of healthy lighting.

The principles included the suggestion that people living in industrialized countries receive both too little light by day and too much light by night for optimal well-being. The CIE also suggested that these principles should lead to a renewed emphasis on architectural daylighting. Daylight is rich in the blue-green area of the visible spectrum (to which the newly-discovered cells are most sensitive) and bright at the times of day that seem most important to regulating circadian rhythms.

The rapid growth in knowledge has spurred the international lighting industry and regulatory communities to develop novel lighting and daylighting products and to propose new standards and guidelines related to lighting and daylighting. Despite the rapid growth in knowledge, important gaps remain for which industry seeks impartial information to support their product innovations and design applications.

Figure 1. A view of nature can help ease the stress of everyday life. (Architect: John Donkin. Photo used with permission: Peter Fritz).

VELUX A/S *(www.velux.com)*

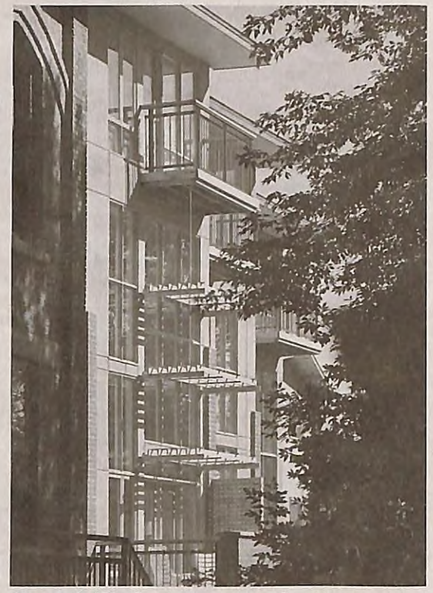

Figure 2: Windows serve many functions. Optimizing their design demands a balance between the simultaneous considerations of providing view, daylight, ventilation, and thermal control suitable to the orientation and climate. (Architect: John Donkin. Photo used with permission: Ewald Richter.)

recently commissioned NRC Construction to review the literature over the decade since the CIE report, particularly focusing on the effects of daylight in residences. The conclusions of NRC's review may be broadly summarized as:

- Human well-being relies on regular exposure to light and dark each day.
- Daylight is the most energy-efficient means to deliver the light exposure.
- Uncontrolled daylight also can cause problems: glare from the sun reduces visibility and causes visual and thermal discomfort.
- The optimal pattern of light and dark exposure, as well as the limits at which daylight control is needed, varies by race, age and individual differences.
- The desire for daylight as the source of the light exposure also depends on how the openings affect the space appearance, on the function of the space, and on cultural norms about privacy, enclosure, and view (Figure 1).
- A view of the outdoors is also a contributor to well-being, particularly if it is a nature scene or similar pleasing sight. Windowless spaces, separating occupants from the outside world, create monotonous conditions that may be stressful.

Using daylight to deliver useful light is sustainable only when balanced against the effects of windows and skylights on the building envelope, ventilation, and overall energy balance. These require climate-based and locally specific solutions that respect other building system considerations and regulations.

The NRC review includes the development of a detailed research agenda showing the information gaps impeding industry advances. Impartial, empirical evidence is needed on these topics in order for industry and regulators to develop products, applications, and regulations that deliver healthful lighting in sustainable buildings, taking into account climate and cultural variations. The following three top priority research domains flow from this analysis:

Establish the optimal daily pattern of light and dark exposures for good mental and physical health. How much light do we need, and at what time? How dark should sleeping rooms be?

Determine how our homes can help us to live in the healthy pattern of light and dark, taking into account the way we use windows and shading to control privacy, glare, and temperature as well as light exposures and view.

Develop design solutions and technologies for different climates that deliver healthy light, warmth, view and fresh air with a minimum of energy use (Figure 2). Specifically, identify ways to provide suitably-sized and located openings in the building envelope to satisfy lighting and view needs while not compromising energy performance.

The results of this review, together with industry consultation about their practical consequences, are influencing the development of new research activities at NRC. External groups developing recommendations for buildings, including CIE, are expected to use the report to guide their decisions. ☼

Details concerning the project are available online at: *http://www.nrc-cnrc.gc.ca/eng/projects/irc/windows-daylight-view.html* or in French: *http://www.nrc-cnrc.gc.ca/fra/projets/irc/fenetres-lumiere-visibilite.html*.
For more information, contact Jennifer Veitch at *jennifer.veitch@nrc-cnrc.gc.ca* or 613-993-9671.

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